The No.1 Aquaponics magazine for the backyard enthusiast.

Edition 13

Bringing Food Production Home

Backyard Aquaponics

Aquaponic trial systems

The final results are in

The Passive Solar **Greenhouse**

Aquaponics at **Comet Bay Primary**

Aquaponics in **India**

Life Raft of Hope

Welcome

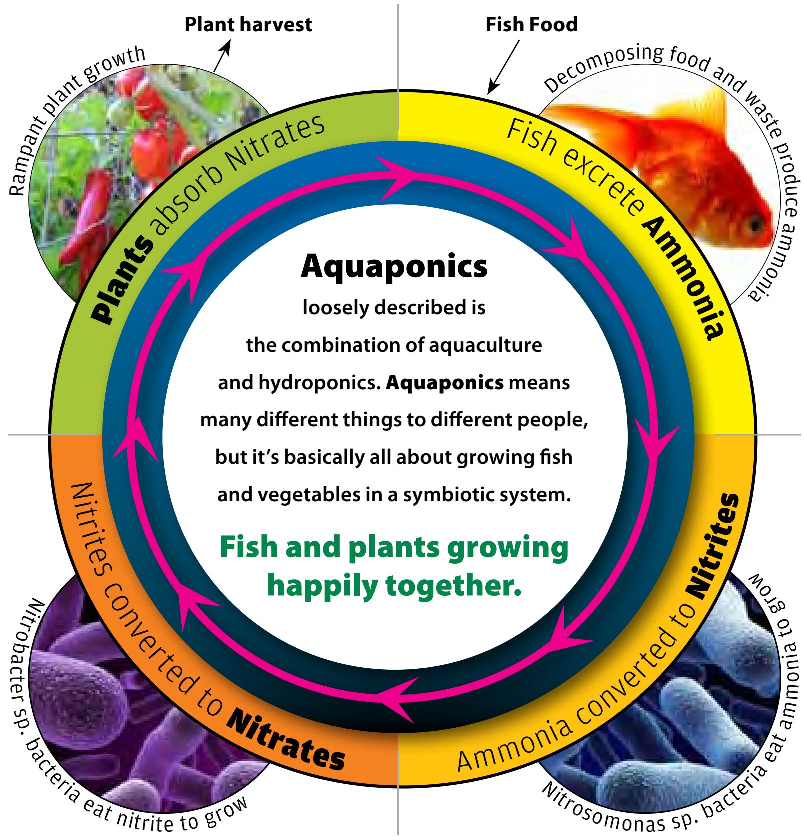
Well they say that the number thirteen is unlucky, personally I'm feeling pretty lucky here unveiling the thirteenth edition while also finishing off the fourteenth edition. Who would have thought it all those years ago, well (4 years ago) when we released the first edition of the Backyard Aquaponics Magazine that we'd actually make it so far. It took close to a year to put together the first edition. So now we find ourselves moving further on, while riding the tide of this aquaponics interest that seems to expand more and more every day. So I'd like to take this oportunity to thank you, the reader, for purchasing this magazine and helping support what we are doing.

The production of this magazine is really just for the love of it. It's not a money making venture, to date not one advertiser has paid any money for inclusion in the magazine, all adverts have been included either because we thought they were deserving people within the industry, or because we've traded something for the advert placement like fish or articles.

This edition, as with every edition, has some interesting articles. A couple of stand out articles within edition 13 are "The Life Raft of Hope" by Marcus Englmayer. Marcus and his family went to India and helped them build a beautiful system at an orphanage. We'll be following the progress in India over future editions to see how aquaponics progresses. There is another stand out article in this edition from Péter Gönczi. Péter lives in Hungary where he faces some quite harsh weather conditions. He has tackled these weather issues by building a beautiful greenhouse with some fantastic thermal efficiency features.

Joel Malcolm, Editor

The Nitrogen Cycle



Backyard Aquaponics on the tube

There are a whole range of aquaponics videos that you can view on YouTube. Visit the link below and see us in action! New videos are added regularly.
www.youtube.com/backyardaquaponics

Backyard Aquaponics

Edition 13

Backyard Aquaponics Magazine
is a quarterly publication which aims to promote the ideas of aquaponics and home food production, coupled with healthy and sustainable living.

ISSN 1837-0942-13

Contributors
Marcus Englmayr, Faye Arcaro, Joel Malcom, John Lawrence, Charmaine Webster, Nat Borbely, Péter Gönczi, Comet Bay Primary School Staff & Students.

Magazine Enquiries
enquiries@byapmagazine.com
Editor: Joel Malcolm
www.byapmagazine.com

Who are We?
Backyard Aquaponics Magazine is produced in-house at Backyard Aquaponics.
PO Box 3350
Success, WA 6964
Ph: (08) 9414 9334

The shop: Cnr Jandakot Road & Berrigan Drive, Jandakot, WA 6164

Editor: Joel Malcolm

Sub Editor: Faye Arcaro

Design & Lay-out: Sarah Upravan
Scott Campbell
David Kyslinger

Front Cover:
The BYAP trial systems at the Jandakot shop. Inset picture is Marcus Englmayr's aquaponics setup in India.

Contributions: The articles in Backyard Aquaponics Magazine are submitted by members of the aquaponics community. The editor of Backyard Aquaponics Magazine reserves the right to determine what is published and has the right to modify submitted material where necessary.

Content Disclaimer: Backyard Aquaponics Magazine is published under the explicit understanding that content contained in the magazine is based on the knowledge and understanding of the contributors at the time of writing. Any statements, advice, or opinions expressed herein are made for the benefit of the reader only. Therefore, Backyard Aquaponics Magazine or its contributors, will not accept responsibility for any damage or loss which has occurred, or may occur as a result of a person's action (or inaction) related to said statements or advice. Backyard Aquaponics Magazine accepts no responsibility for the reliability or accuracy of articles or advertising. Backyard Aquaponics Magazine does not necessarily agree with or accept the views expressed or implied by the contributors.

Contents

life raft of HOPE

By Marcus Englmayr

After spending much of my life working for upper-class people in the building industry, I was itching to do something for people who couldn't pay me back. At least not with money.

I needed a break from rich people who spend enormous sums on small details, knowing that in other countries people were struggling to come up with the bare minimum.

This discontent took me on a journey to a struggling orphanage in a small, poverty-stricken town in India. Here, I learnt that those who survive on so little often have their priorities more right than we do in the west.

Excited to find Tilapia in a nearby pond

When it was time to say goodbye. We put up a feast and they gave us a party

I had always been interested in solving problems in primitive situations. In May of 2010, I visited an orphanage run by a long-time friend in India, an experience that moved me in many ways.

Like many orphanages, this one was struggling and dependent on external sponsorship. Because money was limited, the children ate lots of simple carbohydrates, but not much protein or vegetables. So, there was the concern of malnourishment.

It was while living among these children for two weeks that I got passionate about the idea of setting them up to produce their own food and one day, hopefully, even produce enough to sell so they could be self-reliant and self-sufficient.

Why Aquaponics?

I grew up on a hydroponics farm and have always been interested in fish farming. The two seemed to fit together. I helped a friend set up a backyard aquaponics system in 2008 and got hooked on the idea, setting up a few different systems of my own.

But before I could do any good for these youngsters, I knew I had a whole lot more to learn. So, the rest of 2010 was spent intensively researching, designing, and testing different systems, particularly, flood and drain systems.

My research took me to Hawaii where I was invited by the Friendly Aquaponics crew to do their training. I was very impressed with the simplicity of their Deep Water Culture (DWC) systems. Because India is a very hot place, I needed something that was going to be reliable and DWC seemed to be the way to go. It was simple and stable and if a pump failed, plants would most likely survive for a few days. This meant backup was only needed for the fish.

After many designs and experiments, I finally came up with a one-level system that I was happy with. Everything was at the one level. The only pump needed was an air pump to run airlifts, and I did away with everything that was unreliable and unstable – so no moving parts. My system worked a treat in my first-world home – now it was time to adapt it for the third-world.

Third World Ways

Finding suitable material, tools, and expertise in Australia is one thing, but it's quite another in a small village, far from any industrial centre, in a poverty-stricken country.

I quickly learnt that my mind thinks very 'first-world' and that it is extremely hard to change your thinking to work in a third-world situation.

I was determined, however, to build a system in India that wouldn't need first-world support, tools, or knowledge to run, maintain, or fix.

Hence, the time-consuming task began of sourcing local materials, finding what building methods locals are familiar with, sourcing local labour, and finding appropriate tools.

Speak My Language

As it turned out, it was the holiday/wedding season, so labourers were hard to find. Reliable labourers were almost impossible to find.

But I learnt much from the few dedicated men who stood by me; most importantly, how to manage workers who had never been encouraged to use their initiative, but who were used to being micro-managed.

Workers had the mentality to only work under supervision and when instructed – which was particularly difficult given that I didn't speak Hindi.

After a few weeks, I got a better grasp on the culture and started communicating better with my hands and feet – and the work took off.

Family Ties

While managing a reasonably large-scale building project, there was a plethora of other challenges. Because I had allowed a good three months for the trip, the family was coming along – my wife and two small children, aged one and three. Taking your family into the middle of nowhere is a big challenge.

Particularly challenging for the children was being the only white kids most of the villagers had ever seen. All that attention was scary at first.

But the bigger concern was that our luggage didn't arrive, which contained our mosquito nets and repellants, so in a matter of days, we were covered in spots. Sure enough, we contracted the dreaded malaria.

Overcoming Doubts

Aside from the physical barriers, there was a whole host of emotional reasoning I had to work through.

'Is this even going to work?' 'Is it going to

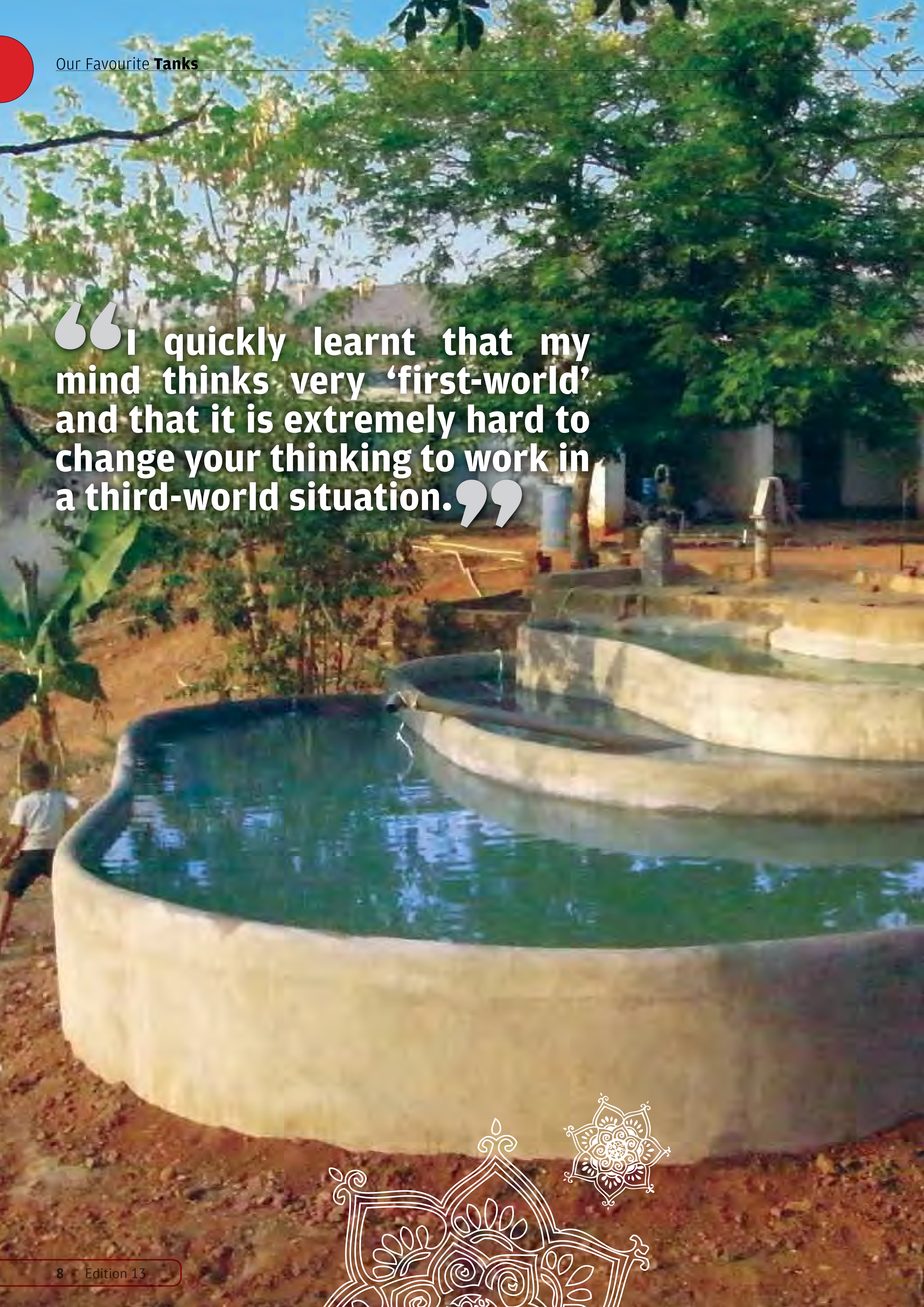
Hatchery tank will also grow duckweed

In times of drought the kids will have food

“We lovingly nicknamed it “life raft” – because it looked like a life raft and was, in fact, built as a life raft of hope for malnourished children.”

This system is designed for multiple purposes

Keeping the mortar moist



“I quickly learnt that my mind thinks very ‘first-world’ and that it is extremely hard to change your thinking to work in a third-world situation.”

The "life raft" would provide food and a source of hope for children like these

be maintained?' 'Am I setting this up and it's just going to go to ruin?'

Only time would tell.

The Life Raft

We did overcome the initial challenges and after weeks of hard work, stood back and admired our new system.

We lovingly nicknamed it "life raft" – because it looked like a life raft and was, in fact, built as a life raft of hope for malnourished children.

Hunting for Fish

With construction complete, it was time to start slowly introducing some life into the system, and what better place to start in aquaponics, than with the fish?

Tilapia is the name of a hardy fish that is very tough, grows quickly, and eats everything, including vegetables. The fish can put up with bad-quality water, if necessary; it breeds easily and is very tasty to eat. I had researched this fish and decided it was ideal for third-world conditions, but where to find it?

I didn't even know what it was called in local language, but tried to describe it in the hopes that locals would understand what I was looking for.

Finally, I learnt of a lake from where I could get it and began a long moped ride with a friendly volunteer and two buckets, through jungles, rice paddies, walk trails and towns to a remote village in the hillsh

Sure enough, there were fish and there were fishermen – but only four fishermen. "We can't go fishing unless we have five fishermen," they explained to me. As a westerner, I didn't understand this way of thinking. Was it superstition or just the way things were done?

But, after days of searching, I was desperate for fish, and after two hours of my most convincing arguments and reasoning, they finally agreed to go. Why they needed a fifth fisherman, I didn't understand for the life of me. One fisherman fished. Four watched...

But, in the space of half an hour, he had caught about 400-500 of my prized tilapia fingerlings with a net and we were off again.

The Story Continues

As tempting as it was to get the whole system into swing while I was there, I knew that slower was better.

There was no point in setting up a system to run at full capacity until I was confident that the people I was leaving it with had enough knowledge, interest, and motivation to continue. So I made the hard choice to leave it running as low-density aquaculture tanks and hold off on the vegetables. I gave lots of instruction on how to look after the system, and we then boarded our train.

I've since been really happy to hear that everything is going to plan. The fish are growing very well and orphanage

Rendering the reed bed

workers have even taken the initiative to make small improvements – moving fish from the hatchery into other tanks to reduce the density, and putting shade over the hatchery tank to keep it cooler in summer. They had taken ownership of the system without any input from me.

That was a really important test and proved to me that it could keep going without me there.

Now the plan is to go back at the end of the year to progress the system and start growing vegetables.

I would love to get a few other people involved – whether they, too, have skills or interest in aquaponics, or whether they can teach some other skill, be it break dancing, soap making, electrics – anything, really. I am keen to get a small crew together for the next trip to do a few weeks of different workshops for these loving children

If you are interested, please contact me on 0421 199 205 or email: markus@ingsi.com.au

HUNGARY
for a life of
AQUAPONICS

By Péter Gönczi

I'm Peter from Hungary. I am a husband, father, and web project manager. My hobby is my backyard. The smell of dirt reminds me of my wonderful childhood summer days on my grandparents' ranch; this helps me to get away from daily stress. I have some dirt garden experience, but no experience with fish/fishing- only that I like to cook them.

Greenhouse construction almost complete. Components cut and ready for installation

A team effort to construct the basement

The handsome one in the light blue T-shirt is Péter

Hungary is a country in central Europe and has continental climate. Most of Europe and North America have quite similar climate. Most aquaponic fans would say it's weather with extremes. The cold winters of the continental and temperate climates are the main withholders for spreading aquaponics over these territories.

My story started last summer. We had a lot of rain and hot and wet is a perfect combination for powdery mildew, which destroyed my dirt garden completly. Meanwhile, my grandparents' small polytunnel (3x4m) supported them well and had a great season. I decided to build a polytunnel! As the winter kicked in, I had nothing to look after in the garden, so I searched the web for layouts and material. In a short time, I switched focus to pit greenhouses, and possibilities of extending growing season. My appetite grew quickly. I wanted a greenhouse for year round gardening with no heating at all!

Continental climate

- The temperature ranges from -17C to 35C (1F to 95)
- Annual average temperature: 10C (50F)
- January (winter) average monthly temperature: -2.6C (27.3F)
- July (summer) average temperature: 20.3C (68F)
- The average annual rainfall is approximately 600 mm (23.6 in)

The Passive Solar Greenhouse

That's how I got to the passive solar greenhouse concept. I loved the idea. It's logical, it's simple, and there is nothing new in it; no moving parts, no tricks, no energy input. The design does everything by itself!

But what is a passive solar greenhouse? It's a building technique that takes advantage of the changing sun angles between summer and winter.

Check out the graphic about how it works (page 14): 1. Passive solar in summer, 2. Passive solar in winter

I also found a solar greenhouse opener that eliminates the use of fans or electric openers to ventilate the greenhouse. It opens and closes the greenhouse window on a selected temperature by a gas piston and a countering spring.

This all sounded nice and easy enough that a handy man could do it by himself. It took a while to convert all available data to the metric system. I drew sketches, calculated and after a week of physics, math and architecture, I felt it could work.

The rules of thumb

- The length/width/height ratio of the greenhouse must be 2:1:1
- Glazing on south wall only sloped the latitude plus 10°
- Thermal mass of water in barrels 200 l/m2 (5 gallons/ft2) of window area
- Insulate all other sides and roof

I will have a greenhouse that is heating itself in the winter, cooling itself in the summer and doesn't need heating or any kind of electric control.

With all the data available about passive solar greenhouses and my calculations, I still had some doubts about it and was hungry for any real life experience in my climate. So, I searched the web for passive solar greenhouse winter videos, which I couldn't find. Instead, I found web4deb's nice, snowy winter greenhouse tour. It's not a passive greenhouse, but has something exciting inside called aquaponics.

Aquaponics

I spent the next few weeks reading about aquaponics. It took a while to understand all of the pros and cons of the different systems so I could plan the project I needed. It had to be compact, as I had limited space. It had to be energy efficient and simple. That was the point where

I realized how far I had come from the original concept of a simple polytunnel, and faced the huge problem of convincing my wife about the costs. Well, that was the hardest part.

Building

The building process lasted a little more than a month, and I'm still not through with it completely. First, I invited some friends to help me out in the most labor-demanding, intensive job digging. It was much fun and a great community event. They named the project "catfish mucker". The concrete slab and the reused brick walls were the non spectacular part, but then things speeded up. I built the frame, wood work, insulation, and glazing, mostly by myself.

For the inside, I designed a CHIFT PIST system from IBC tanks that used every little space available inside the greenhouse. I arranged 7 used IBC tanks and cut them with the least possible waste. In their previous life, they stored some kind of water soluble wood glue in them, which caused some problems later. It's a good lesson to wash them super clean next time.

The cages I used to support the tanks were placed on the heavy duty, wood beam stands. I used the minimum required heights between sumps and grow beds that the siphons needed, and the same between fish tank and grow beds. This way, I kept the pump lift height to a minimum for energy efficiency.

The system

- Fish tank: 1000L (264gal)
- Sump tanks: 3x 400L (105gal) (One of them can be operated as quarantine fish tank, as well)
- Grow beds: 9x 300L (79gal) Affnan siphon
- Media: bottom 2/3 16-24mm crushed stone, 1/3 8-16mm expanded clay
- Pump: Used heating pump, 3500m2/h (925gal/h)

"But what is a passive solar greenhouse? It's a building technique that takes advantage of the changing sun angles between summer and winter."

The pump lift height fluctuates between 90 - 120cms (3 - 4ft), depending on how much water is in the sumps. It could be reduced further by using shallower sumps, or higher diameter irrigation pipes. I chose Affnan mini siphons with 20mm pipes, 20/32mm funnels, 50mm bells, and 82mm strainers. They work rock solid a complete cycle of flood and drain is around 45 minutes.

The solids lifting overflow and irrigation pipes were a different story. Because of the minimum height between overflow point and grow beds, I needed a relatively bigger diameter pipe for the irrigation line to reduce pressure. I wanted at least a 50mm (2 in) pipe, but then I faced the uncertain. The cost of the 9 taps would multiply the cost of the irrigation line by 5. Luckily, we have a type of waste water pipe that is connected with rubber rings; they are not glued, and give a drip-free joint if not under pressure. I did a leveled irrigation line from these, with an elbow over each growbed that acts as a tap. You can adjust and even close the water flow by just turning them. Because of the pipe size, I have some regular algae buildup, but it's easy to clean them once in a month.

The old heating pump that I cannibalized from a boiler is really on the job. It turned out that it's a premium pump with ceramic axis, and with a short 32mm pipe and small lifting height, it works smoothly.

Wels Catfish

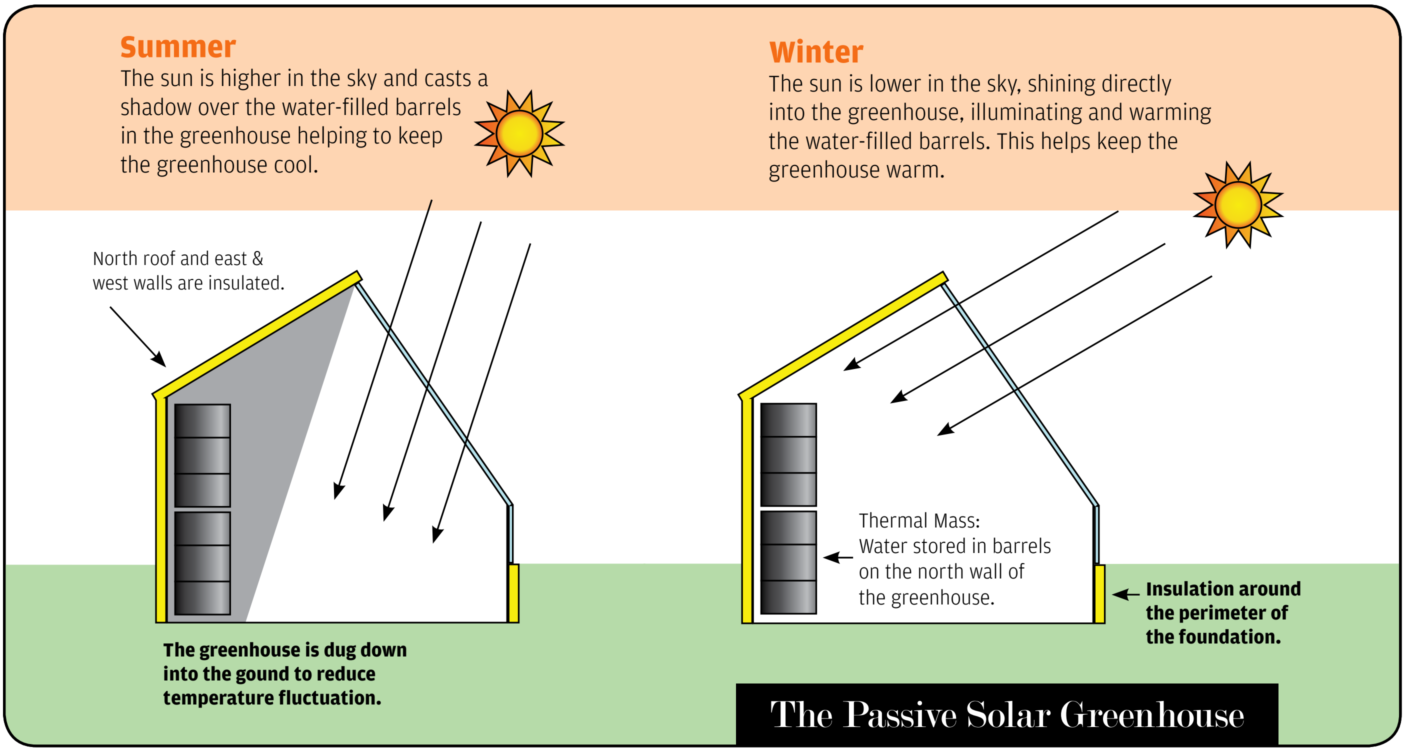
The fish was another hard question. We have lots of extensive fisheries around with a variety of native European fish species, but intensive fisheries are few and they all grow African catfish, which is not native and requires heating. I wanted an inexpensive fish that grows relatively quickly, lives well under intensive keeping, and is not sensitive to water quality. I dug myself deep in native fish species to see my options. Trout fell out because of hot summers. European Perch,

Catfish fingerlings

First tomatoes

Wels catfish

Zucchini



Carp, and Sterlets are slow-growing species, but finally, I found the one that fits all conditions, the Wels catfish (Silurus glanis).

They are native all around east and central Europe, and widespread in western and southern Europe too. They are omnivorous, sometimes even necrophagous, and in favorable conditions they grow fast. Wels catfish can live up to 40 years and reach 100+ kilograms (220+ lbs) and a length of over 2 meters (6,56 ft).

They are hardy, can handle low dissolved oxygen levels and dirty water as well. Extensive fisheries breed and keep them as a byproduct predator that takes care of the smaller fish that are not welcome in their production.

They are easy to get, but you have to teach them to forget their predatory instinct and eat pellet instead, and this seems to be the hard part.

I bought two branches of catfish from different sources, and was unlucky with both. They died after a few weeks without any clear reason, but I'm not giving up. It has to be some water quality issue and I blame the wood-glue remains that I was unable to clean from one of my IBCs.

The Question Remains...

Bottom line, I created a system that could be a sustainable, competitive, energy efficient solution for colder climate aquaponic enthusiasts. How it performs, will it work throughout the winter, and does the idea of all-year-long growing without heating stay a dream? These are questions that only time can answer, and we have to wait for the first winter to declare whether the theory worked or not.

CELERY

By John Lawrence

Apium graveolens, commonly known as celery, is a reflux trigger for some people. On the other hand, some can eat tons of it without so much as one burp! Celery belongs to the plant species Apiaceae, like parsley, carrot, anise, caraway and dill.

Can you believe that its closest relative, Apium bermejoi (closely related to the wild celery) is critically endangered? The sad news is that there are fewer than 100 individual plants left, all growing on the island of Minorca. It is considered one of the rarest plants in Europe. The reason for its endangerment is loss of habitat.

Fortunately, the common celery, as we know it, does not share the same ill fate, and one can only hope that people will become more responsible in using the resources that Mother Earth has so graciously given us to prevent this from ever happening.

The uses of celery around the world vary from culture to culture. It is widely consumed as a vegetable and can be eaten in its crisp state (leaf stalk), while some people prefer to eat the top root (celeriac), which is fleshy in texture. Some growers are interested only in the seed, which yield a valuable oil used in the pharmaceutical and perfume industries. Some cultures prefer to consume the seed to flavour their food, either ground or whole, often mixed with salt known as celery salt. Celery salt can also be produced using an extract of the root. To season cocktails - notably the Bloody Mary, a barman will use celery salt, accompanied by a celery stick for aesthetic purposes.

When in Louisiana, you will be offered Creole and Cajun dishes made with onions, bell peppers, and celery it's in fact, said to be the holy trinity of ingredients in those regions. Celery is used as a staple in a myriad of soup mixes, as well. We also share our love of this tasty vegetable with a few other distinguished gastronomes such as birds, squirrels, small rodents, pigs, dogs, and horses!

When we talk about the various medicinal benefits that vegetables have to offer us, we must, without a doubt, include the use of celery for the treatment of many ailments. As far back as 30AD, Aulus Cornelius Celsus described the use of celery for relieving pain. It is well documented that celery seed can lower blood pressure in rats. It is said to help arthritis sufferers, as well. Some use it as an aphrodisiac, because it is thought to contain testosterone properties, however, this

Great celery growth in amongst the other plants in the BYAP growbeds

"Eat a few sticks of celery in winter, as it will help boost the immune system due to its high content of vitamin C."

is a misunderstanding and the placebo effect is most likely at work here.

Celery is a popular food source in weight-loss diets, as it provides low calories and high dietary fibre. If you want to build strong bones in children, then give them a stick or two of celery a week, as it is high in calcium.

Eat a few sticks of celery in winter, as it will help boost the immune system due to its high content of vitamin C. Make it interesting for children by serving it with avocado or mayonnaise dips or place some on a skewer with their favourite meat, and presto - the kids eat food that is good for them without realising it!

A final remark: Celery is among a small group of foods that can provoke severe allergic reactions in some people. Exposure can cause fatal anaphylactic shock. In the European Union, the problem is considered so severe that foods have to be clearly marked if they contain celery or even trace amounts of celery.

GOLDFISH

By Charmaine Webster

There is a record, which still stands today, of the largest goldfish in the world. It measured nearly 48cm long and was living in the Netherlands at the time. Coming in second, was a goldfish in England, which measured 38cm long, and 0.91kg in weight. There are probably a few bigger goldfish in the world whose owners don't really want all the fanfare surrounding such a feat.

They are kept as pets around the world and are bred for their pretty colours and shapes. Interestingly, although they have a memory span of three months, they can distinguish between different shapes, sounds and colours. By giving a goldfish some positive reinforcement, they can even be trained to recognise and react to light signals of different colours, or even to perform tricks.

Distribution

This fish, which was originally a wild carp is also known by such names as the Gibel Carp, Golden Carp, and Crucian Carp. They did, however, originate in China, Central Asia, and Asia. These fish inhabit slow moving or stagnant freshwater of rivers, ponds, lakes and ditches. In the 1600s, they were exported first to Japan and then onwards to Europe where they were developed into their wonderful forms and colours you see today. The common goldfish comes from the more than 125 captive bred varieties worldwide.

History

It has a long and illustrious history. In the ancient world, various carp, collectively known as Asian carps were domesticated and were used as food fish for other species. Some naturally grey or silver species have a tendency to produce orange, red, and yellow mutations, which was first recorded in the Jin Dynasty.

In the Tang Dynasty, however, it became popular to raise carp in ornamental ponds and water gardens, mainly by the elite of that time. A natural genetic mutation produced gold rather than silver, and this became a widely popular variety to keep in captivity. It was very common to move the gold variety into smaller containers to be used as a main focal point at dinner parties and such at that time.

In 1162, the Empress of the Song Dynasty wanted an elaborate pond constructed so that she could collect gold and red varieties. It must be noted that people outside the imperial family were forbidden to keep goldfish of the gold variety, because (yellow) was the imperial colour. This could be the reason why we see more orange goldfish than gold (yellow) fish, even though the latter is far easier to breed.

The fancy tailed goldfish was first recorded in the Ming Dynasty. In 1502, goldfish were introduced to Japan where the Tosakin and Ryukin varieties were developed. In 1611, the goldfish were introduced to Portugal and from there it spread through Europe.

In the southern parts of Europe the fish were highly regarded for their metallic scales that symbolised good luck and fortune. Husbands would give their wives a goldfish on their one-year anniversary as a symbol of the prosperous years to come. As goldfish started loosing their status, most of these traditions died out.
It was first introduced to North

America around 1850 where it quickly became popular.

Biology

The fish's scientific name is Carassius auratus auratus, in the family Cyprinidea of the order Cypriniformes. It was one of the earliest fish to be domesticated in ancient times.

Goldfish breeds can differ greatly in body-shape, size, fin configuration and colouration, having combinations of white, yellow, orange, red, brown and black.

The common goldfish is an elongated fish, with a flat body. The most distinguished feature is a bright orange metallic colour. It has a wide, but short, head. It has a smoothly tapering body shape from its back and belly to the base of its caudal fin, which is forked. It has fully erect fins in general, with a slightly concave dorsal fin.

The environment it finds itself in will eventually determine its size and weight, the more space they have, the bigger they will grow. In an average 38 litre tank, they can easily grow to 10cm, while in larger, uncrowded tanks, they can grow even larger, generally to about 18-20cm.

In the wild, goldfish are normally olive green to aid as a camouflage to predators. However, once they are introduced into the wild, they can cause all sorts of problems for native species of fish. The reason for this is that they can easily hybridise with other species of carp.
It will only take three generations of breeding and the majority of goldfish spawn can revert to their natural olive colour. Koi can also interbreed with goldfish, producing a sterile, hybrid fish.

Goldfish come in many varieties. The fancy goldfish cannot survive in the wild, however, because of their bright fin colours. The hardier varieties, such as the Shubunkin, may survive just long enough to breed with wild cousins. The common goldfish, as well as the comet

Beautifully coloured goldfish

“In the southern parts of Europe the fish were highly regarded for their metallic scales that symbolised good luck and fortune.”

goldfish, can survive in any climate that can support a pond.

Diet

The goldfish is one of the most interesting and efficient fish when it comes to absorbing nutrients from their food. They, in actual fact, have no stomach, as such. Most surprisingly of all, however, is that they have a set of teeth to get the digestion rolling.

Why this fish evolved this way no one knows, but once the food is in its mouth, it is pushed to the back of the throat where a set of tiny teeth grind and crush the particles against a hard pad.

The gall bladder and pancreas play a big role in that they pump chemicals in with the food. Once that has been done, the gall bladder makes up bile, which is, in turn, used to break down fats. The chemicals secreted from the pancreas contain enzymes that are used to break down proteins.

Its entire digestive tract has layers of cells that secrete enzymes reacting with carbohydrates that break them down into sugars. The expanded section of its anus produces a mucus-like substance and as much as possible is absorbed into the bloodstream to be utilized for cell repair, growth and energy.

Its digestion process takes about 16 hours, but will slow down during cold periods. That is why goldfish should not be fed when it is cold. The food will only end up rotting inside of them and that which they do not ingest, end up rotting in the pond or tank water.

The nature of the goldfish's digestive system also suggests that it is vital to feed them small meals throughout the day, rather than one or two big meals. Big meals will not be in the goldfish long enough to be broken down and most will be discarded before it has a chance to breakdown into important nutrients.

What Do They Eat?

In the wild, their diet consists of insects, crustaceans, and various plant matter. They are opportunistic feeders and do not stop eating on their own accord. Overfeeding can, thus, be fatal. With excess food available, they produce more waste and faeces partially due to incomplete protein digestion. You will know if your fish is being overfed if their faeces are trailing from their cloacae.

Specially formulated food has less protein and more carbohydrates than conventional fish food. It is sold in two consistencies: pellets that sink and flakes that float. Many enthusiasts may supplement the fish's diet with shelled peas, plant roots, algae, tadpoles, snails, smaller fish, bloodworms and blanched, green leafy vegetables. They would use the flakes and pellets only as a base in their diet.

Fingerlings will benefit from adding brine shrimp to their diet, which will give them a great boost in growth. In keeping them healthy and disease free.

Live food such as midge larvae, freshwater shrimp, and daphnia is the most nutritional of all for a goldfish. Make sure that the live food you introduce does not come from a place where it was exposed to pesticides. It is, thus, best to breed your own live food, so that you are certain that it is disease and chemical free.

You could also grow your own aquatic plants in a separate tank to feed your goldfish.

They love fruit and vegetables as well, provided they are cooked and grated finely enough to digest. They will also love carrots, peeled grapes, lettuce, apple and pears. Fruits like raspberries can be dropped in whole and the fish will pull the smaller parts off. This will also give them a challenge by giving them something to do.

Use the fruit and vegetables as treats and nibbles only, and not as a major part of their diet.

Red Cap Oranda Goldfish

Breeding

Goldfish will breed in captivity during spring, and only when the water temperature is warm enough to sustain their eggs. The act of mating is sometimes seen as aggressive, but the male will chase females around, bumping and nudging them so that they release their eggs. Their eggs will attach to aquatic vegetation. They will, ideally, hatch within 48 to 72 hours of being laid.

The fry will assume the final shape within a week, although a year may pass before they develop into a mature goldfish colour. Until then, they stay a metallic brown like their wild ancestors. They grow rapidly in their first week of life, which probably was due to the high risk of being devoured by adult goldfish or other fish in their environment.

Some bred goldfish have lost the ability to breed naturally due to their altered shape. Hence, artificial breeding methods such as "hand stripping" are used, but it normally harms the fish if not done correctly.

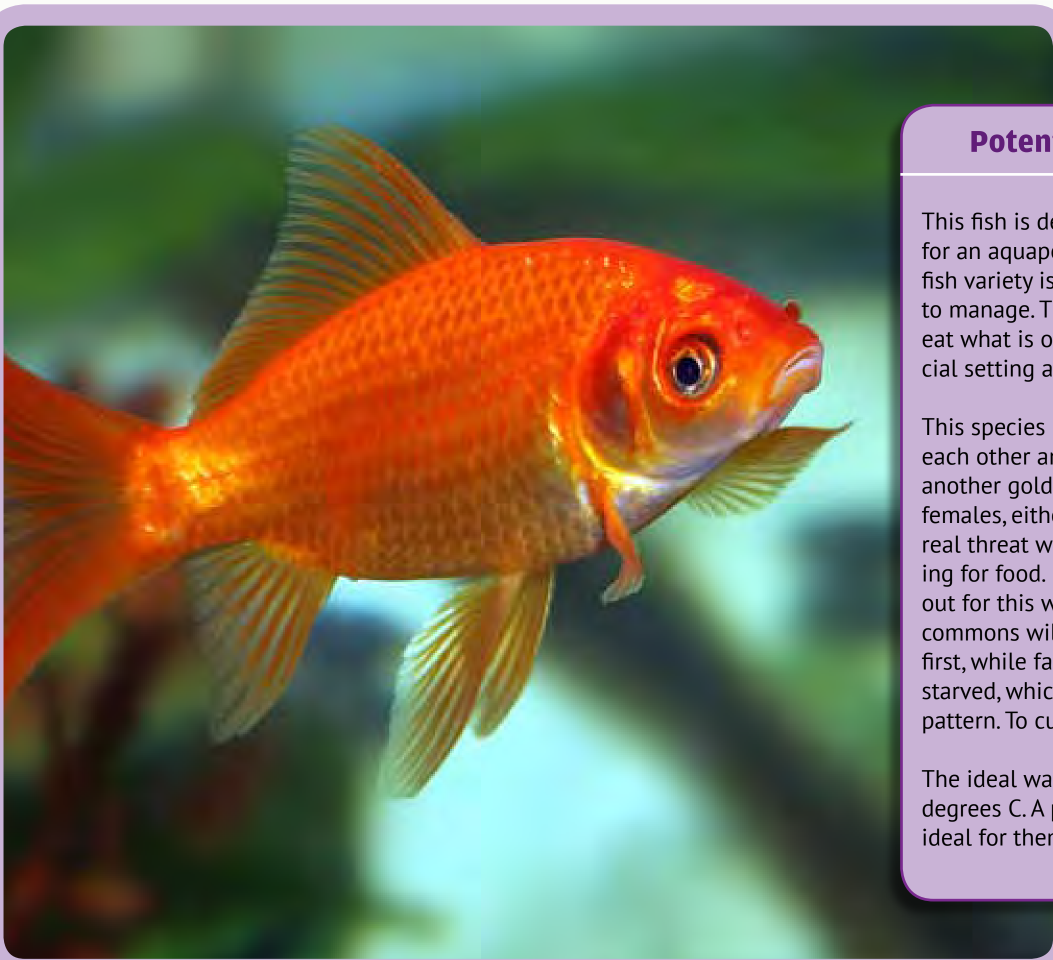
Husbandry and Health

Because they are inexpensive, colourful and small, they are very popular pets to have in tanks and ponds. The common goldfish, such as London and Briston shubunkis, wakin, jikin and comet are hardy fantail fish that can be kept all year round in temperate and subtropical climates. Veiltail, moor, oranda and lionhead can be kept in outdoor tanks or ponds only in summer and in more tropical climates.

Tanks should be at least 80 centimetres deep to avoid freezing. Goldfish will become sluggish during winter, stop eating, and will usually stay at the bottom of the pond or tank. It is normal for them to do this and will become lively and active again in spring.

A good filter system is essential to clear out the waste and keep their environment clean. You could add some plants, as they will be part of the filter system, as well. They could also be a good food source for the fish and can raise oxygen levels in the water.

Try to keep from touching the goldfish because it can endanger their health. They have a protective slime coat which, if removed, will expose the fish's skin to infection from bacteria or water-born parasites. They do respond to humans by surfacing at feeding time. If well looked after, they could last you 10 years or longer.



Potential for Aquaponics

This fish is deemed most desirable to have for an aquaponics system. The common goldfish variety is recommended, as they are easy to manage. They are not fussy and will readily eat what is offered. They thrive well in a social setting and in a fairly large community.

This species is commonly friendly toward each other and very rarely would harm another goldfish. The males do not harm the females, either, during breeding. The only real threat which presents itself, is competing for food. It is, thus, imperative to watch out for this when you feed them. Comets and commons will dart fast to get to the food first, while fancy fish will be left hungry and starved, which will lead to a stunted growth pattern. To curb this, do not mix varieties.

The ideal water temperature would be 22 degrees C. A pH balance of 6.5-8.5 is also ideal for them.

comet bay primary school's backyard AQUAPONICS

In 2009, two teachers, Mrs Maccarone and Mrs Barrett signed up for the Stephanie Alexander Kitchen Garden Project for our school. Successfully, our school got the program. When the money came in last year, Mrs Maccarone, Mrs Barrett, and Mr Osborne, the principal of our school, thought it would be a good opportunity to set up an aquaponics system. Mrs Maccarone and Mrs Barrett went to the Royal Show to find out about it. They came back with heaps of information and told their classes all about aquaponics. We kept on talking about the aquaponics until we got it, because we were very excited.

To set up the aquaponics, we chose 50 silver perch. We chose silver perch, because they seemed like the easiest to start with. This year, we added 4 yabbies 2 big and 2 small. The fish eat floating fish pellets. They are very shy and black. We feed them 3 times a day. The fish only come out when Mr Osborne gives them their food. Last year our class learnt about the structure and the life cycle of a fish. The fish have doubled in size from about 6 to 12cm.

The plants we have planted in our system are carrots, eggplant, tomatoes, snow peas, Japanese turnips, capsicum, spinach, thyme, marigolds, basil, parsley, purple beans, tatsoi, mizuna, silverbeet and tea herbs. We learnt how to plant and care for the plants in our aquaponics system.

In our science program, year 4/5 classes have been looking at the life cycle of a plant and what it needs to grow healthy and strong. Last year we measured the growth of a plant that we chose to monitor. Some of them died through the year. However, we have had some successes, especially with the spinach, which we then used in a variety of recipes in the kitchen.

The idea behind the Stephanie Alexander Kitchen Garden Project is to grow, harvest, prepare and share fresh produce from our garden. Students from our class have held several information sessions to tell parents, teachers and other students all about the aquaponics and the cycle that helps fish and plants grow together, called the nitrogen cycle. We will be doing more learning sessions this year.

When we started the aquaponics system, some of the people in year 4/5 gave up a day in the holidays to plant some vegetable seedlings in October 2010.

We learnt about the nitrogen cycle and how it works to benefit the fish and the plants. We also learnt that the nitrites are poisonous to the plants and the nitrates are poisonous to the fish. We also made a poster about it, using diagrams and information from Faye at Backyard Aquaponics.

We visit our aquaponics regularly to plant, harvest or just to check if it's still running properly. Several classes throughout the school visit the aquaponics every couple of days. We think Mr Osborne has names for the fish because he calls them his pets.

Mrs Gill's class has been checking the aquaponics quite regularly to see if the plants have any bugs, and if they are healthy. They also measure the fish to see if they are growing at the right speed and if we are giving them the right amount of food at the right time. When they plant new seedlings, the class gets very excited. They check the season before they plant seedlings, because they need to know if it's going to grow. They get pebbles out of the tank and pipes so the filter does not stop working. LA14 (Mrs Gills class) sees if the tank is clean and if there are any weeds, they will pull them out so they don't take up space. If there are pests, they will spray them with natural bug spray so that they don't eat up the plants and kill them. When people harvest, they see if they are doing it properly and make sure they are not taking more than they need.

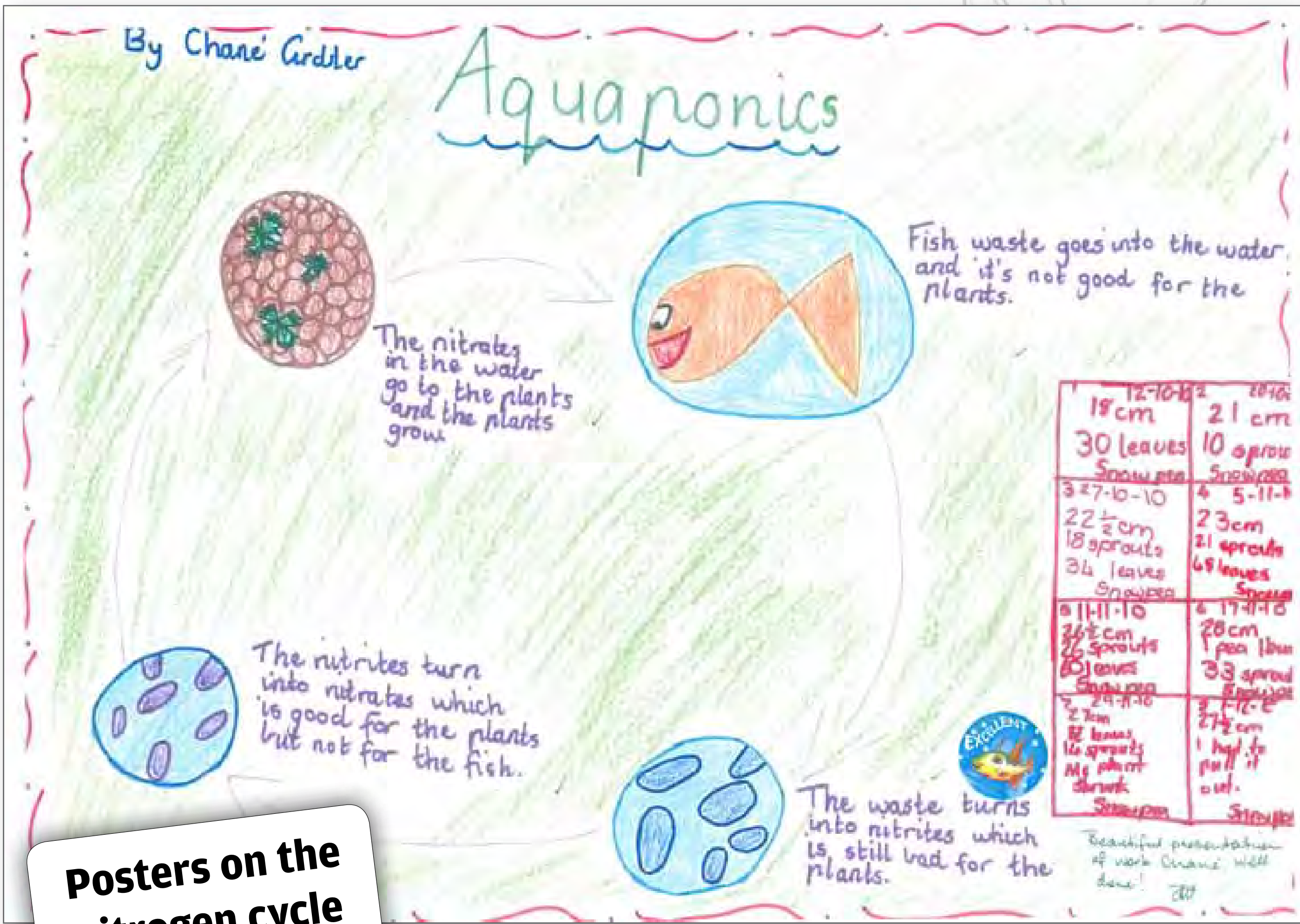
Our class used the spinach to make mini quiches to take on our excursion to Point Peron, and some other vegetables from our garden went into a salad to eat with them. It was a yummy lunch!

"When I went to the aquaponics, I picked out the weeds and looked for bugs. I got a fluro green caterpillar and about 6 bugs on the plants," said Blake Dobson.

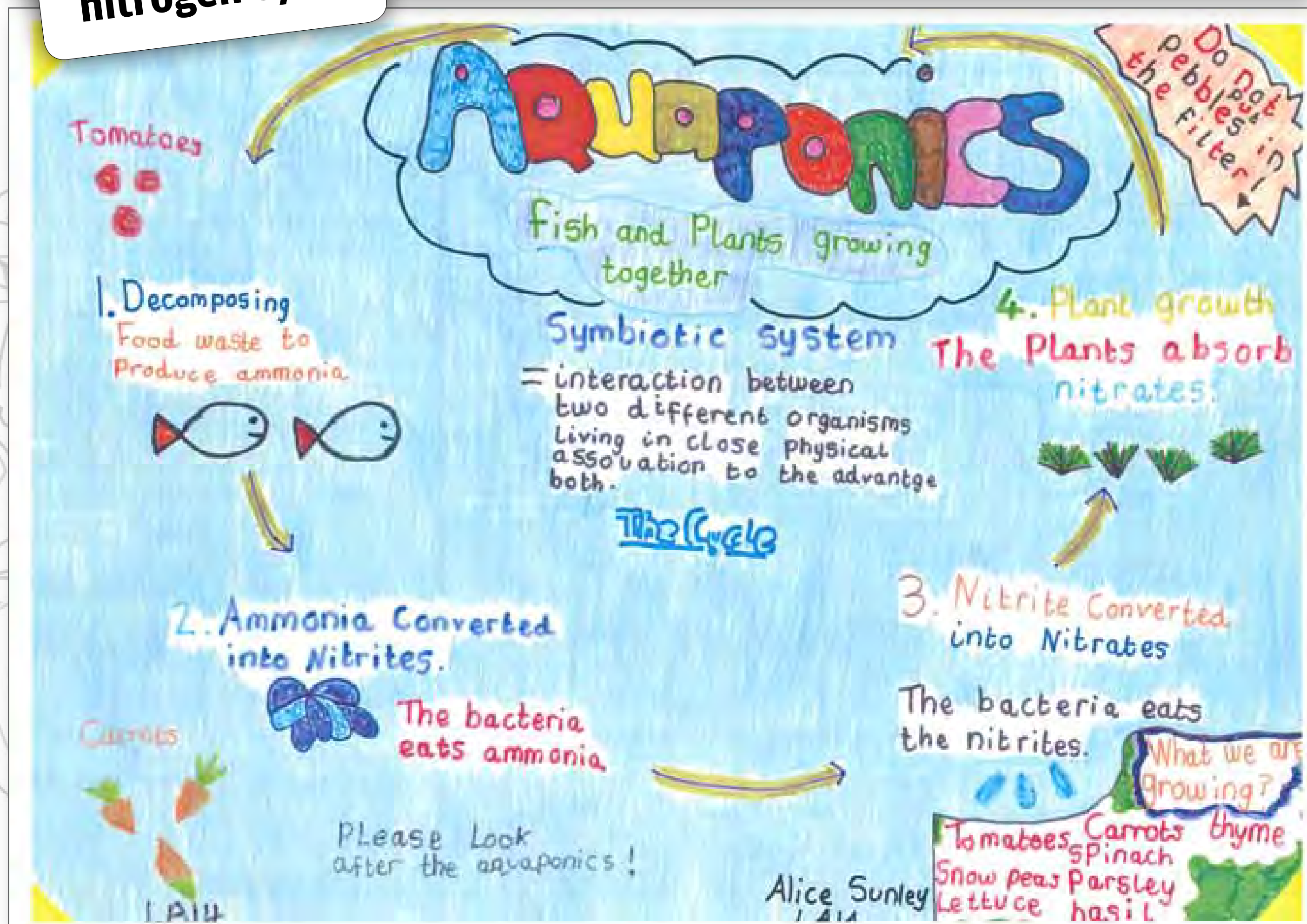
"The aquaponics is a great thing to have at our school. It is a learning experience and a great way to learn about healthy eating. It's fun to go and have a look at the plants," said Elliot Jackson.

"I like the plants and what we are growing. I want to see the fish and how big they are," said Alice Sunley.

"We learnt about the nitrogen cycle and how it works to benefit the fish and the plants."



Posters on the nitrogen cycle



"I like the way the aquaponics works. It's awesome that the plants and fish grow together in the cycle," said Rourke La Reservee.

Chloe Dixon said, "I like the aquaponics because of all the fruits and vegetables we get from the aquaponics and it is good to cook with. It is also fun learning about the fish and plants."

"I like the aquaponics. Beans taste good and I like them," explained Zayne Doherty.

"What I like about the aquaponics is that I can learn heaps about the fish and heaps more!" Bailee Wharerau.

Jason Smithdale said, "I really enjoy the aquaponics, because it is an amazing system and it's great fun watching the fish."

BASICS OF COOKING FISH

By Nat Borbely

If you, like millions of others, love eating fish, then you need to know the basics of how to fry, grill, bake, or poach your fish so that you can get the most out of it. Fish is good for us and we should be eating a lot more of it. The experts say we should be eating at least two portions of fish (fresh, frozen, or canned) a week. One of these should be an oily fish such as salmon, pilchards, or sardines (but not tinned tuna, only the fresh variety).

Firstly, you must avoid overcooking your fish. It should not flake, because that is an indication that it is drying out. To know when fish is cooked properly, the colour turns from translucent to opaque (white).

Handle the fish gently to maintain its "just caught" appearance and texture. Unless, you grow your own fish, you should always get your fresh fish from a fish monger if possible, and freeze it the same day if you are not going to use it. Thaw in the refrigerator overnight, rinse well in cold water, and pat dry before preparing.

Never be nervous to try different methods of preparation. You can grill it, pan fry it, steam, or poach it. All you need is the correct utensils, seasoning, and versatility.

Let's look at some tried and tested methods of preparing fish

Sautee (pan fry) You could use this method to cook fish fillets or fish steaks. You will need some oil and a non-stick skillet. Your heat should always be medium to medium high. Cook the fish only for 8 minutes until brown, turning once half-way through cooking time. You could also dip the fish in beaten eggs and bread crumbs, which will give you a crispy texture.

Steaming If you want to make a fish stew, then you can gently boil the fish and other ingredients together by following your recipe. You could also steam the fish by placing it on a rack over boiling water. The pot should be covered with a lid and the steam will cook the fish marvelously.

If you are pressed for time, you could use the microwave to cook your fish. Place it in a small amount of liquid and cover with a plastic wrap that has one or two vent holes. Cook on high power for about 3 minutes, turning only once. Add salt after cooking.

Poached Any fish may be cooked in this method. All you would need is a flavoured liquid such as wine, water, fish stock, or milk. You place the fish in the liquid; cover with a lid keeping just below boiling point. Your fish should be done in about 8-10 minutes if you have pieces and 15-20 minutes if you have a whole fish. You can then use the poaching liquid as a base for a fish sauce.

Grilling This is the tastiest way to prepare fish. Preserve the fish's moisture by coating it with oil. Watch over the fish meticulously and flip them over as soon as they are cooked half-way through. You could also wrap them in aluminium foil or place them on top of the foil on the grill. This way the juice will be maintained and it will not dry out the fish.

Ceviche This method uses lime juice flavoured with herbs and chilli to soak pieces of white fish overnight. The lime "cooks" the fish with the acid content in the lime juice. You can also use this method with flatfish, such as flounder and sole, or snapper.

Frying in batter This is also another great way to prepare fish. Your batter needs to be the right consistency, i.e. it should be thick enough to stay on the fish. The fish has to be patted dry and the oil needs to be on medium-high heat. To make a batter, you take a cup of flour, a cup of milk, a half a teaspoon of cream of tartar or baking powder (makes the batter crispy), some salt, and one egg. Mix together, and let it stand for about 20 minutes. In the meantime, dry off your fish and coat it with flour. Dip the fish into the batter and immediately place it into the oil. You could deep-fry or light-fry your fish, whichever way you prefer, and season to taste.

Lacewing

Regarded as a general predator and not a pest by many gardeners and crop growers, this little insect can save an entire crop within a few days. The most common lacewing in Australia and other parts of the world is the green lacewing. They are easily spotted by their bright green elongated bodies and their beautiful lace-like clear wings.

By Faye Arcaro

For all their splendour, they only live three to four weeks. However, in those four weeks, they can make mince of your infestations quite easily.

The green lacewing is widely distributed in Australia and is well-suited to a wide variety of crops and habitats. They are particularly active in warm climates; however, they tend to hibernate in cooler weather. Adults will feed on nectar and pollen. Ideally, you would want some flowers around your crops, so that they are able to feed naturally.

If you are not partial to using chemicals on your plants, then you might want to seriously consider the lacewing to help you curb your infestations from time to time. They are nature's helpers, do not cause damage to your plants and can be helpful in sustaining organic food sources, naturally.

Biology

Lacewing (Chrysopidae), is found in the order Neuroptera, meaning net-winged insects, including mantidflies and antlions and their relatives. This order contains some 6,010 species.

The adults possess four membranous wings, with the forewings and hind wings being the same size and with many fine veins. Their wings have specialised sense organs and fine bristles, or other structures to link their wings together during flight. The wingspan is from 6 to over 65mm, though the largest forms are tropical. They have special

organs on their forewings, enabling them to "hear" well. Some will even show evasive behaviour when they hear bats approaching. They will typically close their wings while in flight, making their signals smaller and, hence, cannot be detected easily.

They are soft-bodied and delicate insects with a few specialised features. They have large, lateral, compound eyes which are conspicuously golden in many species. Some have the ability to release a vile smell when handled.

The common green lacewing use substrate or body vibrations as a form of communication between Individuals, especially during courtship. Some species, which are identical morphologically, may sometimes be separated more easily through their mating signals.

Their larvae are highly specialised predators, having elongated mandibles adapted for piercing and sucking. The larvae, in general, have three pairs of thoracic legs, each ending in two claws. The abdomen has adhesive discs on the last two segments. Because they are voracious predators, attacking most insects of suitable size, they are often referred to as lions or aphid wolves. Although their senses are weakly developed, they are very sensitive to touch. They tend to walk around in a haphazard fashion, swaying their heads from side to side.. When they do strike they inject a special substance into their prey dissolving the organs of their prey in around 90 seconds!

Diet

Lacewing larvae prey on aphids, two spotted mites, greenhouse whiteflies, scales, mealybugs, moth eggs and small caterpillars.

These wide ranging predators will easily attack and eat almost any small insect or egg. An average larva can eat about 60 in one hour; multiply that by 1000 and you get a good idea of how quickly your crop or your prized ornamentals could be saved.

The lacewing adult does not feed off plants at any stage of its life cycle and will only eat nectar and pollen from flowers, honeydew produced by aphids, and ther insects. Therefore, they will not cause any harm to your plants whatsoever.

Habitat

They can be found in crop fields, greenhouses, house plants, common gardens, vegetable patches, and just about any place where flowering plants grow;

Have some of these companion flowers growing in-between your crop or your ornamentals: basket of gold, buckwheat, butterfly weed, carpet bugleweed, chamomile, chervil, chives, clover, cornflower, cosmos, coreopsis, cinquefoil, coriander, dandelion, dill, fennel, four-wing saltbush, golden marguerite, marigold, mustard, parsley, Queen Anne's lace, scented geraniums, spike speedwell, sunflowers, tansy, vetch, wild carrot, and yarrow.

Repoduction

Lacewings need a place to over-winter. Provide some loose mulch, leaf litter and rocks or logs where they can safely hibernate. They will always over-winter in the cocoon stage.

They live approximately four weeks and can lay up to 600 eggs. Each egg will be perched on a slender stalk which elevates it from the surface, which decreases the chance of predation by ants. The eggs take about four days to hatch.

Larvae range in size from 1 mm at first emergence up to 8 mm just before they pupate. They have small spines on their backs upon which they impale the remains of prey.

This provides a form of camouflage and allows the larvae to appear inconspicuous amongst the prey.

Larvae pass through three moults over a period of 12 days before pupating inside a silken cocoon. Adults emerge after nine days and start laying eggs seven days after emergence.

Lacewing eggs

Introducing them to your plants

If you do not have lacewings in your area and you do not have the time to introduce companion plants just yet, then you could order them from a supplier. It is best to release your lacewings before other pests can reach damaging levels. Stay away from pesticides within three weeks of release.

You would, ideally, despatch your lacewings when they are in their egg stage. They will hatch into the larval stage during transit. The eggs are packed with lucerne chaff, in lots of 100 to 500, depending on the supplier. They will also have some sterilised moth eggs as a food source while they are on their way to you.

Release them in their second stage of larval development. You will know when the time arrives when they are significantly bigger, which indicates the second stage, so check the package frequently. If you can, get some smaller release boxes so that you can sprinkle the larvae in between your plants. This will ensure that they remain in the plants, especially if you hang the boxes on twigs or branches. This will give them protection and a ready food source.

If you have field crops, you would need about 20000-50000 lacewings per hectare. However, if you have a backyard garden or greenhouse, then the number needed for an individual situation can be determined after consultation with the supplier. Always release the lacewings directly in pest hot spots to ensure they have an immediate food supply. Make releases about 10 to 14 days apart to improve establishment. They will take about 12 days to develop before they pupate in cocoons. After this time, there will be enough lacewing larvae in the area, as it only takes 16 days before the adults are able to lay eggs.

Adults fly at night, so ensure that night lights are turned off as they are attracted to light. They are not that difficult to detect during the day and you might find them being more mobile than their prey. They can be spotted moving over plant leaves and stems. Their eggs are distinctive, because they are usually perched on long, slender stalks. You can start your lacewing scouting approximately 30 days after releasing larvae.

Remember that lacewings will persist feeding on pests only if nectar and pollen are present. Encourage flowering plants to grow at their optimal level, and you will have a helper in the garden to get rid of your pests for a long time.

If, for some reason, you cannot release the larvae once you have received them, you should store them in a cool dark place until you are ready. Remember to turn their holders upside down daily to allow re-distribution of their included food supply. Unfortunately, if their food supply does run out before you can release them, they will cannibalise each other.

The next time you spot a lacewing on your plants, do not kill it. It is obviously there because you have pests in the garden unknowingly. Leave them be, so that they can breed and eat off other bugs which do cause havoc to your plants. They deserve to be respected as a gardener's helper and be given consideration when detected.

> **"For all their splendour, they only live three to four weeks."**

the BIG BYAP experiment Part 3...

By Joel Malcolm

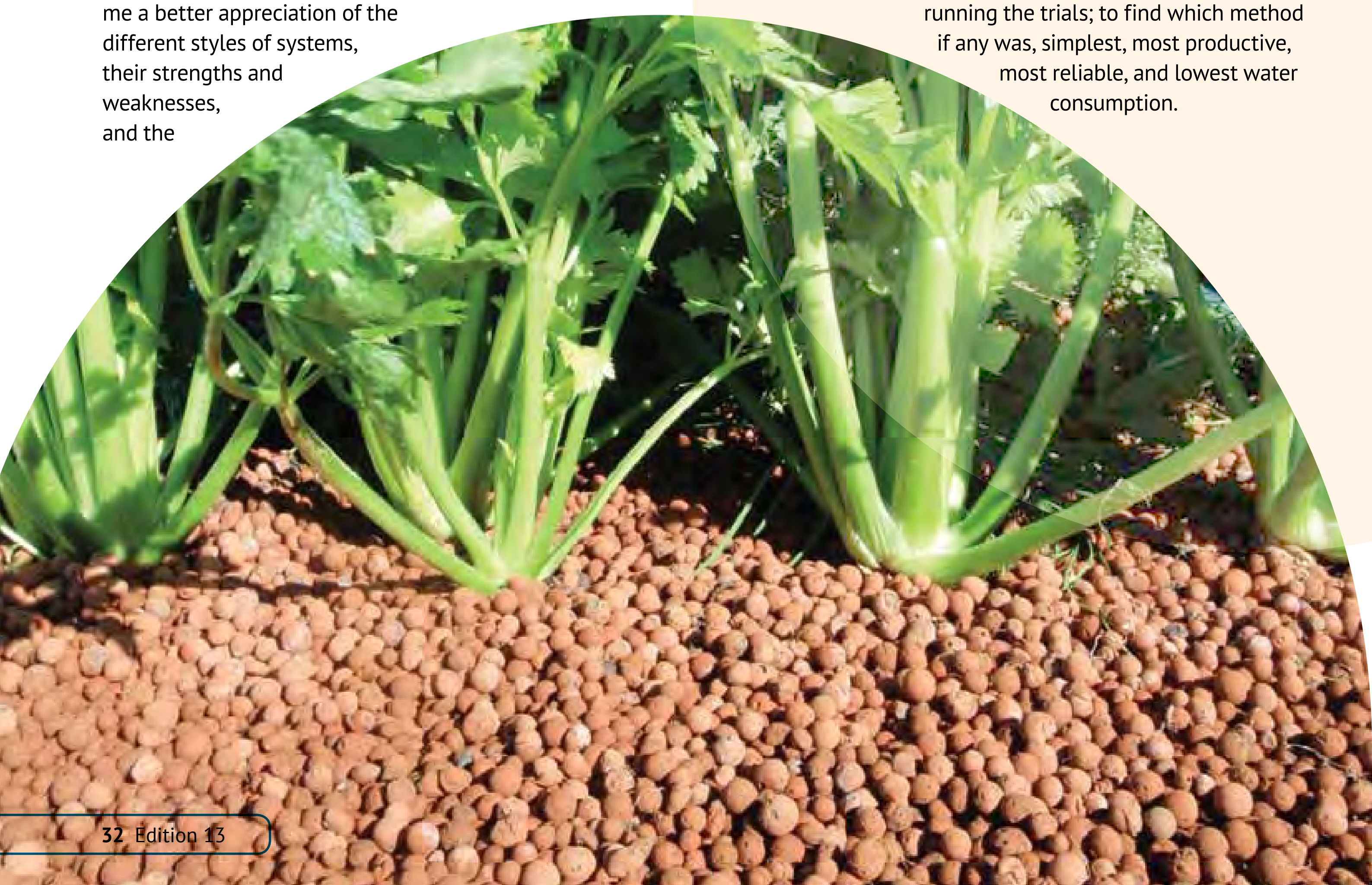
We are going to wrap up the trial and look at the final results. The results in this edition and over the 12 months we ran the trial, are very interesting to say the least.

In some cases, the results were quite surprising, at least they were to me at the time. It's certainly helped give me a better appreciation of the different styles of systems, their strengths and weaknesses, and the background knowledge to be able to confidently offer my opinion on the three styles of system.

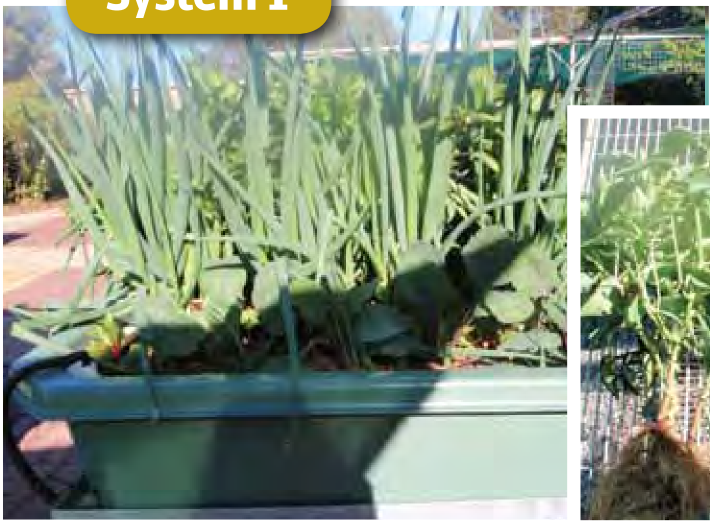
Many aquaponics practicioners have a favourite style of system, generally what they use in their own systems unsurprisingly. I imagine that I've been just as guilty of this as any other person with an aquaponics system.

Personally I've had a range of different styles of systems, though over the past four or five years I've concentrated on and supplied systems using a standpipe and a timer running with a pumping cycle of 15 minutes on, 45 minutes off.

Why? Because it's worked well. Was it the best way? Who knows, this was one of the main reasons behind the idea of running the trials; to find which method if any was, simplest, most productive, most reliable, and lowest water consumption.



System 1



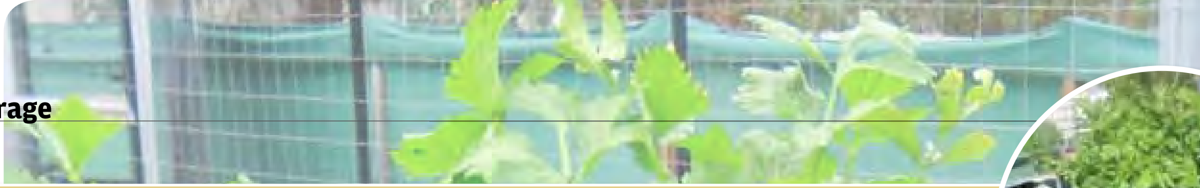
Auto Siphon

System 2

Constantly Flooded

System 3

Standpipe and Timer

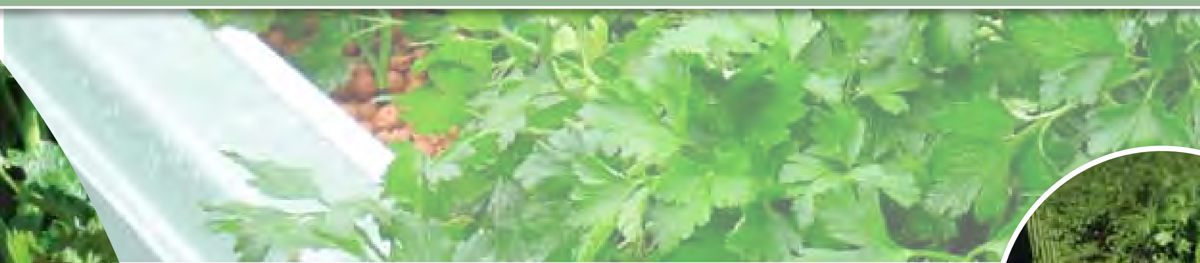


System 1

Flood and drain running on a siphon in the growbed. The system was very slow to get started, the fish didn't want to eat as much as in the other systems within the first 3 months. The siphon, once going, was fairly reliable. It stopped twice that I know of during the 12 month trial, but was easily restarted. Once the system kicked into gear, probably at about the 3-4 month mark, it started producing very well. There was a period of time over winter where the crops looked better in this system than either of the other systems. Overall, the first system didn't quite perform as well as the other two. During the last 3-6 months of the trial the system was producing as well as could be expected.

System 2

System 2 was the dark horse in my opinion. It exceeded my expectations of production and surprised me with what grows in a **constantly flooded system**. The growth of both the plants and fish in this system has been great. From the very start the system performed well right through to the 12 - month mark and beyond. Most surprising was that plants I thought wouldn't do well with their roots submerged all the time, produced very well. Thyme for example, a plant well known for liking reasonably dry conditions, grew very well in the constantly flooded bed. Although this system used more power than system 3, it used the same as system 1, and yet didn't have the point of failure of a siphon stopping. To date, it's now been running well past the 12 month mark and it's still performing extremely well.



System 3

Flood and drain on a timer. This is the style of system we've been using on our kit systems for over five years now. We know that it works and it's reliable, but we wanted to put it up against the other methods to see how it compared. Although it was a little slower to get going than system 2 at the beginning, it was quickly a leader in plant growth for the first 3-6 months. Plant growth was consistently highly productive over the 12 months, apart from the time when some pest infestations destroyed the crops. The fish were noticeably hungrier in this system as a general rule, hence the greater feed levels in this system compared to the others.

Fish

Fish weights and feed conversion ratios. After 12 months we weighed a sample of 6 fish from each system. System 1 averaged 224g/fish, system 2 was 234g while system 3 averaged 252g. Over the period of the trial we only lost one fish from system 2, not bad loses from 75 fish at the start.

Total feed levels to each system varied quite a bit. System 3 took the most feed by far. There was a lot of debate on the forum about how we were feeding the systems. Many people felt that we should be feeding measured doses to each system so they all received the same levels of feed. Part of our whole idea behind this trial was "real world" situations, how people would be operating the system at their house according to fairly common operating guidelines. Our system operating guidelines had always been that once a system was cycled, you then feed as much to the fish as they wanted to consume. If they don't want to eat, then you don't feed them. This meant that because the fish didn't want food in system 1, the system got off to a much slower start and over all, wasn't quite as productive as the others.

Plant growth

Plant growth and vegetable production was hard to quantify and evaluate over the 12 months that we ran the trial. We took a series of photos of the harvests from each system, but could see no sense in weighing the produce or trying to quantify the difference between the systems too closely. During the 12 months, harvests generally seemed to be larger in system 3, but then towards the end some large crops of capsicum (peppers), as well as a crop of tomato and silverbeet were decimated in system by pests that we didn't notice till it was a bit too late to deal with them.

Water consumption

Water usage has varied over the three different systems. Over the 12 month period, it varied from 4379, 4675 to 5352 litres. So why did system 3 use about 1000L more than the others? Because for a few months of this time it had more plant growth within the system than the other two; at least this would seem a logical explanation. The more plants there are, the more transpiration and the more water bound up within the plant. Still, over all water use is low in comparison to dirt gardens, and you also have the fish on the side, almost as a by-product of your water efficient gardening.

Conclusion

So, all in all an interesting experiment with some surprising results, especially with the growth of some plants in the constantly flooded system. A slightly disappointing start for system 1 with the siphon, but it came in strongly towards the end. System 3 performed fairly strongly throughout, but really, at the end of the day, all systems have performed well. As to which type of system you should set up yourself, well it's really a matter of personal taste.

Glossary

Acidic	Having a pH of less than 7
Aerobic	Requiring, or having abundant air
Aggregate	Course material including crushed rock or gravel
Alkaline	Having a pH above 7
Ammonia	Produced by the fish in their waste and through the gills, can build up becoming toxic if not diluted or converted in the system
Anaerobic	Dead zones caused by lack of oxygen, harbour bacteria, and release harmful toxins
Aphid	Soft bodied, sap sucking insects may be white, yellow, black, or green
Aquaculture	The cultivation of aquatic animals and plants in a controlled environment
Aquaponics	Symbiotic relationship of plants and fish growing together in a system
Autosiphon	Useful mechanism for controlling flood and drain cycles of a grow bed
Bacillus thuringensis	Naturally occurring micro-organism effective as a treatment against caterpillars. Certified organic and not harmful to beneficial organisms
Bacteria	Naturally occurring microscopic organisms, both good and bad
Biological filter	Place that supports the colonisation of nitrifying bacteria, eg. growbed
Blue metal	Greyish coloured crushed rock or aggregate, usually granite
Broodstock	Mature fish used for spawning and the production of young
Buffer	Additive which resists changes in pH when small quantities of an acid or alkali are added
BYAP	Backyard Aquaponics
Calcium	Silver/white, soft alkaline earth metal. Necessary for plant growth
Calcium carbonate	Found naturally in chalk, limestone, and marble. Used to buffer pH
Carnivore	An organism that feeds mainly or exclusively on animal tissue
CHIFT PIST	Constant height in fish tank - pump in sump tank
Chloramine	Combination of ammonia and chlorine usually used as a disinfectant and water treatment
Chlorine	Powerful bleaching, disinfecting agent. Used for producing safe drinking water
Clay	Naturally occurring, consisting of fine-grained minerals which hardens when fired or dried
Coir	Natural fibre extracted from coconut husks
Cycled	When a system has established populations of beneficial bacteria
Cycling	The process of establishing bacteria populations in a system
Dechlorinate	To remove chlorine
DWC	Deep water culture: hydroponic method of growing plants suspended in nutrient rich water
Deficiency	A lack or shortage of
Detritus	Waste or rotting matter in the bottom of a fish tank
Dissolved oxygen	A measure of oxygen dissolved, in or carried in, a given media
DWV	Drain waste vent: type of pipe and fittings used for drain waste and vent plumbing
Ebb and flow	The process of flooding and draining a media-filled growbed
Expanded Clay	Clay pellets fired in a kiln which expands into porous “balls”
FCR	Feed conversion ratio: amount of feed fed to an animal, compared to weight it puts on
Fingerling	Young fish that have developed to about the size of a finger
Flood and drain	Flooding and draining fish water in a media filled grow bed.
Food grade	Components made to a standard for coming into contact with food stuff
Fry	Young or very small fish
Fungicide	Chemical compounds used to kill or inhibit fungal spores or fungi
Gravel	Rock particles
Growbed	Where the plants grow in an aquaponic system
Growing media	Substrate for bacteria habitat and plant root anchoring
Hybrid	The offspring of two animals or plants of different breeds, varieties, species, or genera
Hydroponics	Growing of plants without soil
Hydroton	Type of expanded clay/clay balls with high water storage capacity
IBC	Intermediate bulk container to store and transport liquids
Irrigation	Artificial application of water to land or soils
LECA	Light expanded clay aggregate
Lime	Calcium oxide. Extracted by heating limestone, coral, seashells, or chalk. Used for buffering pH
Limestone	Sedimentary used for buffering pH
NFT	Nutrient film technique where plants are suspended in a small enclosed gutter and a thin film of water is passed through the roots to deliver nutrients
Nitrate	Naturally occurring nitrogen available for plant use

Nitrite	Produced as part of the nitrogen cycle, highly toxic to fish
Nitrogen cycle	Process which nitrogen is converted between various chemical forms
Nitrobacter	Bacteria which oxidises nitrite into nitrate
Nitrosomonas	Bacteria which oxidises ammonia into nitrite
PPM	Parts per million
PPT	Parts per thousand
Purge	Removal of impurities by cleansing
PVC	Polyvinyl chloride- plastic polymer
Salt	Mineral mainly composed of sodium chloride
Species	Biological classification for a group of organisms capable of interbreeding and producing fertile offspring
Standpipe	Standpipes set the maximum water level in a grow bed, and excess water that is pumped into the bed goes straight over the top of the standpipe and down the drain
Standpipe surround	Casing for the standpipe which allows water to flow through pre-drilled holes
Stormwater	Water that is derived during rain events
UV stabilised	Substance/object protected from long-term effects of light and ultra violet exposure

Ammonia Toxicity Chart

Total Ammonia Nitrogen (TAN) - ppm											
Temp (°C)	pH										
	6.0	6.4	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.4
4	200	67	29	18	11	7.1	4.4	2.8	1.8	1.1	0.68
8	100	50	20	13	8.0	5.1	3.2	2.0	1.3	0.83	0.5
12	100	40	14	9.5	5.9	3.7	2.4	1.5	0.95	.61	0.36
16	67	29	11	6.9	4.4	2.7	1.8	1.1	0.71	0.45	0.27
20	50	20	8.0	5.1	3.2	2.1	1.3	0.83	0.53	0.34	0.21
24	40	15	6.1	3.9	2.4	1.5	0.98	0.63	0.4	0.26	0.16
28	29	12	4.7	2.9	1.8	1.2	0.75	0.48	0.31	0.2	0.12
32	22	8.7	3.5	2.2	1.4	0.89	0.57	0.37	0.24	0.16	0.1

Fruit & Vegetable **Planting Guide**

*For Northern Hemisphere **(NH)** & Southern Hemisphere **(SH)***

Spring

NH: March, April, May | *SH: September, October, November*

Artichoke
Beans
Cantaloupe
Carrots
Collards
Corn
Cucumber
Eggplant

Garlic
Herbs
Kale
Kohlrabi
Leeks
Lettuce
Melons
Mustard Greens

Okra
Onions
Parsley
Parsnips
Peanuts
Potatoes
Pumpkins
Radish

Spinach
Squash
Strawberries
Swiss Chard
Turnips
Tomatoes
Watermelon
Zuccini

Summer

NH: June, July, August | *SH: December, January, February*

Beans
Chard
Corn
Garlic

Herbs
Lettuce
Mustard Greens
Onions

Okra
Peppers/Capsicum
Spinach
Radish

Squash
Tomatoes

Autumn/Fall

NH: September, October, November | *SH: March, April, May*

Beetroot
Bok Choy
Broccoli
Brussels Sprouts
Cabbage
Carrots

Cauliflower
Celery
Endive
Garlic
Kale
Kohlrabi

Lettuce
Mustard
Onions
Parsley
Peas
Radish

Spinach
Sugar Peas
Swiss Chard
Turnips

Winter

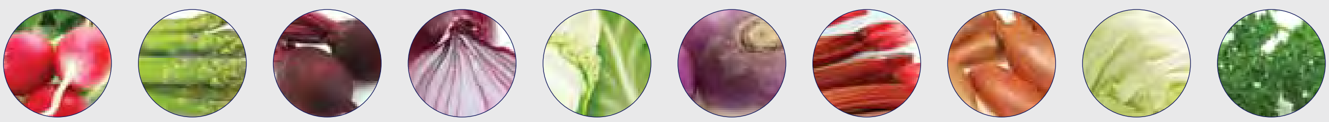
NH: December, January, February | *SH: June, July, August*

Asparagus
Beetroot
Broccoli
Brussels Sprouts
Cabbage
Cauliflower

Endive
Horseradish
Kale
Kohlrabi
Lettuce
Onions

Parsley
Parsnips
Peas
Radish
Rhubarb
Shallots

Spinach
Swiss Chard
Turnips



Conversion Table

Metric Length		Imperial
1 millimetre [mm]		0.03937 in
1 centimetre [cm]	10 mm	0.3937 in
1 metre [m]	100 cm	1.0936 yd
1 kilometre [km]	1000 m	0.6214 mile

Imperial Length		Metric
1 inch [in]		2.54 cm
1 foot [ft]	12 in	0.3048 m
1 yard [yd]	3 ft	0.9144 m

Metric Volume		Imperial
1 cu cm [cm3]		0.0610 in3
1 cu decimetre [dm3]	1,000 cm3	0.0353 ft3
1 cu metre [m3]	1,000 dm3	1.3080 yd3
1 litre [l]	1 dm3	1.76 pt
1 hectolitre [hl]	100 l	21.997 gal

Imperial Volume		Metric
1 cu inch [in3]		16.387 cm3
1 cu foot [ft3]	1,728 in3	0.0283 m3
1 fluid ounce [fl oz]		28.413 ml
1 pint [pt]	20 fl oz	0.5683 l
1 gallon [gal]	8 pt	4.5461 l

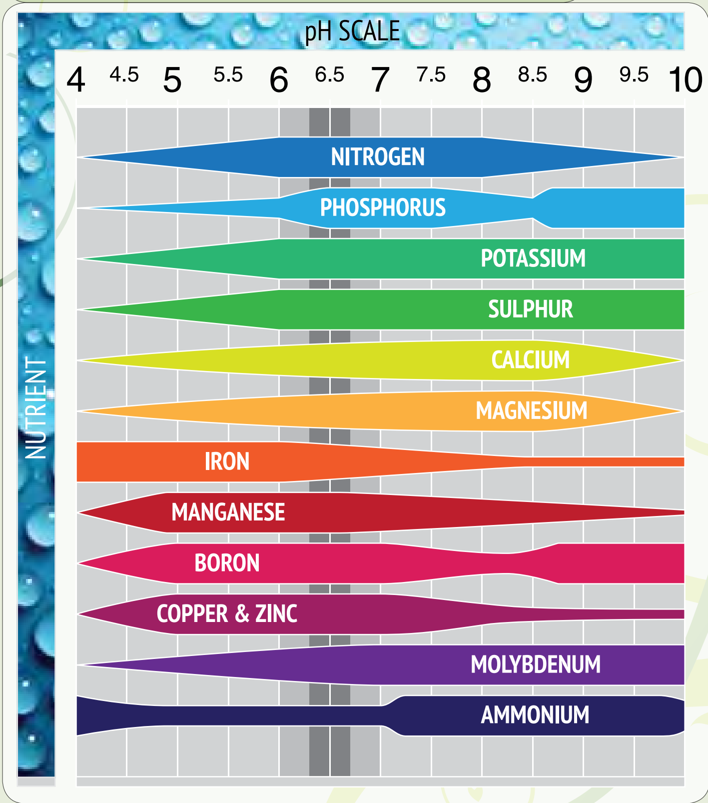
USA Volume		Metric
fluid ounce	1.0408 UK fl oz	29.574 ml
1 pint (16 fl oz)	0.8327 UK pt	0.4731 l
1 gallon	0.8327 UK gal	3.7854 l

Metric Mass		Imperial
1 milligram [mg]		0.0154 grain
1 gram [g]	1,000 mg	0.0353 oz
1 kilogram [kg]	1,000 g	2.2046 lb
1 tonne [t]	1,000 kg	0.9842 ton

Imperial Mass		Metric
ounce [oz]	437.5 grain	28.35 g
1 pound [lb]	16 oz	0.4536 kg
1 stone	14 lb	6.3503 kg
1 hundredweight [cwt]	112 lb	50.802 kg
1 long ton (UK)	20 cwt	1.016 t

Temperature Celcius		Fahrenheit
0 °C		32 °F
5 °C		41 °F
10 °C		50 °F
15 °C		59 °F
20 °C		68 °F
25 °C		77 °F

pH v Nutrient Scale



Want to buy back editions of the magazines in a package and save money? We are selling back editions in a bundle so that you can collect every edition, and save yourself money at the same time. Don't forget, you can download all future editions at your own convenience from our website.

Work is well under way on the **fourteenth edition** of the magazine. We will continue to showcase systems belonging to members of the online discussion forum, there will be information on vegetables and plants well-suited to aquaponics systems, plus lots of useful hints and tips.

It's promising to be an exciting issue, packed full of information.

Edition 14 OUT SOON

Backyard Aquaponics Magazine
Future Editions and Subscriptions

The ***Backyard Aquaponics Magazine*** can be purchased and downloaded in PDF format from ***www.byapmagazine.com*** either as individual issues, or as a yearly subscription. Alternatively, we can mail past issues 1 to 5 on CDROM and 5 onwards as a printed edition.

If you have any queries, please don't hesitate to contact us.

Backyard Aquaponics
PO Box 3350, Success.
Western Australia, 6964
+61 (08) 9414 9334
magazine@backyardaquaponics.com